Multi-format, Multi-standard Waveform Monitors

▶ WFM700HD • WFM700A • WFM700M

The WFM700 Series of Multi-format Waveform Monitors offers the monitoring capabilities needed in the production, post-production, distribution, and transmission of high-definition (HD) and standard-definition (SD) digital video content.

For mixed HD/SD environments, the multi-format **WFM700A** gives you the tools you need to perform operational monitoring tasks like checking signal validity and content quality, setting levels, and verifying signal paths. The **WFM700HD** offers an HD-only version of these same capabilities. The **WFM700M** offers all the capabilities of the WFM700A plus the digital analysis capabilities important in the design, installation, and maintenance of digital video systems, including eye diagram with automated measurements, jitter, and data measurements for both HD and SD formats. With available digital audio monitoring support, you can expand the capabilities of any WFM700 configuration to monitor both digital video and audio in a single instrument.

These products combine the best of traditional waveform monitors with the measurement accuracy, repeatability, and stability achievable with fully digital technology. Their modular design lets you purchase the capability you need now and add capabilities later as your requirements change. Backed by Tektronix innovation, service, and support, these modular, multi-format, fully digital waveform monitors lower your cost of ownership while offering powerful tools for monitoring digital video and audio signals.

▶ Features & Benefits

Monitors SD and HD Digital Component Video – Single Product for Both Standards

Exclusive Diamond, Split Diamond and Arrowhead Displays Offer Unique Insight Into the Gamut Compliance of Your Content

Safe Action and Safe Title Graticules Help Editors and Operators Easily Identify Incorrectly Positioned Video Content

Multi-mode Display Improves Efficiency by Letting You View a Wide Variety of Displays Simultaneously

Closed Caption Detection and Decode Let Operators Quickly Verify Correct Closed Captioning in the Video Content

Ancillary Data Analysis Reduces the Time and Effort Needed to Isolate and Diagnose Problems in the Data Content of Video Signals

HD/SD Eye Pattern Display with Automated Measurements and Jitter Display improve Efficiency in the Installation and Maintenance of Digital Video Distribution System (M module only)

Digital Audio Monitoring Capability with Surround Sound Display Verifies Compliance of Digital Video and Digital Audio Signals in a Single Instrument, Conserving Space, and Lowering Capital Expenses (requires purchase of additional module)

TFT Color LCD Display, with Integrated Touch Screen Control, Provides a Unique, Flexible User Interface with Intuitive, Status-at-a-Glance Operation

Remote Interface for Access and Control From Any Location

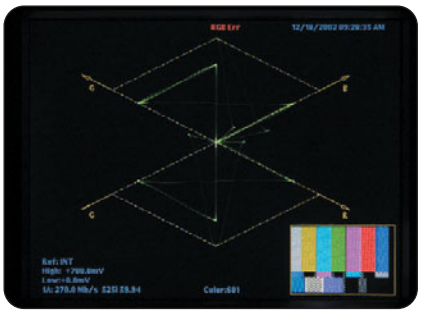
▶ Applications

Quality Control in the Production and Post-production of HD/SD Digital Video Content

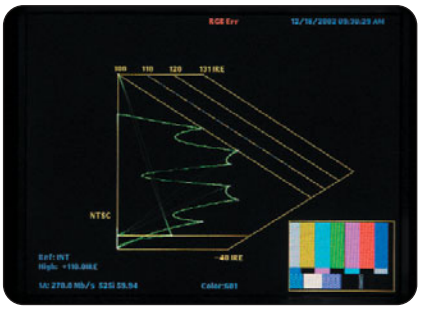
Monitoring and Compliance Checking in the Distribution and Broadcast of HD/SD Digital Video

Video Equipment Qualification and Troubleshooting in the Installation and Maintenance of HD/SD Digital Video Facilities and Systems

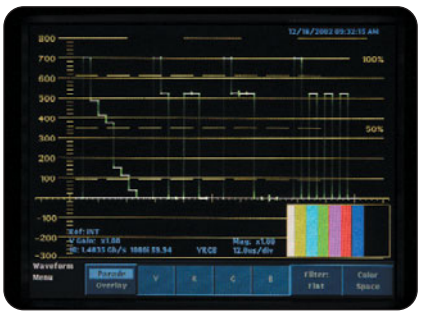
Tektronix
Enabling Innovation



▶ *WFM700 Diamond display.*



▶ *WFM700 Arrowhead display.*



▶ *WFM700 YRGB Waveform display in parade mode.*

Tektronix Exclusive Color Gamut Monitoring

Problems with production and operational equipment can introduce illegal colors in the digital video signal, i.e., colors that fall outside established gamut limits. Every member of the WFM700 Series has the following Tektronix patented gamut monitoring displays:

- Diamond and Split Diamond – monitoring for RGB gamut compliance
- Arrowhead – monitoring for composite gamut compliance including luma+chroma and separate luma limit checking

With these specialized displays you can significantly reduce the time and effort needed to perform this critical quality control task.

Familiar Waveform Monitoring Displays and Controls

All WFM700 models offer familiar waveform displays. You can view digital video signal components in either an RGB, YRGB, YP_bP_r color space, displayed in parade or overlay mode. The YRGB color space combines the Y luminance signal with the RGB component signals to give you benefits from both traditional color spaces.

In addition to these digital waveform displays, the WFM700 products can also display a familiar composite representation of an SDI digital signal.

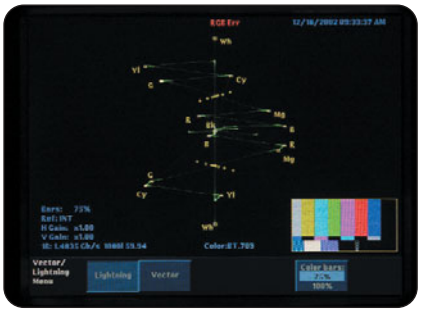
Every WFM700 model offers a rich set of familiar waveform display controls including:

- 1-line, 2-line, 1-field, and 2-field sweep selections
- Line and field selects
- Flat and low-pass filtering
- 1x, 5x, 10x and variable gain settings
- 0% and 7.5% setup levels in the composite waveform representation
- Offset and aligned chroma settings in YP_bP_r color space
- Horizontal magnification
- Selectable graticules including mV, IRE, and % scales

Tradition and Innovation in Monitoring Color Amplitude and Timing

Complementing these full-featured waveform displays, every WFM700 product offers two specialized displays for monitoring the color information in digital video signals.

- The traditional Vector display for monitoring P_bP_r color amplitude
- The Tektronix-patented Lightning display for monitoring luma and chroma amplitudes and interchannel timing



▶ *WFM700 Lightning display.*

Automatic Detection of a Wide Range of Signal Formats

All WFM700 models have two terminating inputs for serial digital signals in either SMPTE 292M format (WFM700 HD, WFM700A, and WFM700M) or SMPTE 259M format (WFM700A and WFM700M).

The monitor will automatically detect the signal format and establish the appropriate settings for the various displays.

All models accept an external reference signal for synchronization. You can let the instrument automatically detect the external reference signal format or manually select any of the following formats: NTSC, PAL, 1080i (50 Hz, 59.94 Hz, 60 Hz), 1080p (23.98 Hz, 24 Hz), or 720p (59.94 Hz).

▶ *WFM700 Video Session display.*

▶ *WFM700 Auxiliary Data Status display.*

▶ *WFM700 Ancillary Data display.*

The following table shows the supported signal formats:

Standard	Physical Interface	Image Format	Field/ Frame Rate 60 Hz	Field/ Frame Rate 59.94 Hz	Field/ Frame Rate 50 Hz	Field/ Frame Rate 30 Hz	Field/ Frame Rate 29.97 Hz	Field/ Frame Rate 25 Hz	Field/ Frame Rate 24 Hz	Field/ Frame Rate 23.98 Hz
274M	292M	1920x 1080i	X (D-292)	X (E-292)	X (F-292)					
274M	292M	1920x 1080p				X (G-292)	X (H-292)	X (I-292)	X (J-292)	X (K-292)
274M	292M	1920x 1080sF				X*2	X*2	X*2	X	X
240M/260M	292M	1920x 1035i	X (A-292)	X (B-292)						
296M	292M	1280x 720p	X (L-292)	X (M-292)	X				X	X
ITU-R BT.601*1	259M	720x 576i (625)			X (C-259)					
ITU-R BT.601*1	259M	720x 483i (525)		X (C-259)						

*1 ITU-R BT.601 defines sampling for SD serial digital video per SMPTE 259M and ITU-R BT.656.

*2 These segmented-frame format signals are detected as their corresponding interlaced format.

"Status-at-a-Glance" Video Session Display

In addition to detecting a wide range of video signal characteristics, the WFM700 waveform monitors offer valuable status and error reporting capabilities, like the unique Video Session display. This display summarizes a variety of statistics relevant to video content health and standards compliance, including:

- Signal format and colorimetry
- Stuck bits indicator
- Presence or absence of ancillary data, including embedded audio, closed caption data, or timecodes
- Presence or absence of color gamut errors
- CRC values
- Errored seconds, errored fields, and % errored fields statistics

Timing Reference and Auxiliary Data Monitoring

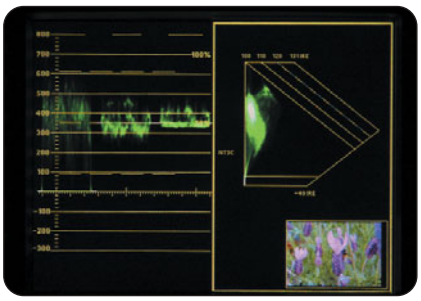
Every WFM700 Series product can detect information contained in the horizontal and vertical synchronization intervals in the digital video, including:

- Start-of-Active-Video (SAV) and End-of-Active-Video (EAV)
- Error detection and reporting per SMPTE RP165 for standard definition and SMPTE 292M for high definition
- Presence of closed caption information in accordance with EIA608 and, if presence, decode and display the data on picture display
- Presence of closed caption information embedded in accordance with EIA708 and ARIB B37 standards
- Ancillary Time Code (ATC) and Vertical Interval Time Code (VITC) values
- Presence of V-chip data and, if presence, the decoded rating information
- Presence of ARIB STD-B39, ARIB STD-B35, ARIB TR-B22, and ARIB TR-B23

Depending on your preference, WFM700 waveform monitors can either show the SAV and EAV in waveform display or strip out this data prior to display.

▶ *WFM700 picture display with decoded EIA608 Closed Caption data.*

▶ *WFM700 Event Log.*



▶ *WFM700 Multi-mode display.*

The Ancillary Data Display helps you view information contained in any ancillary data packet by specifying the appropriate first data identifier (DID) and secondary data identifier (SDID). All WFM700 Series waveform monitors can display the data as a table of data words in hex format. The display can also show information on data block and count, packet type, and checksums.

User-adjustable Alarms and Event Logging

Further enhancing the capability available with the Video Session display, all WFM700 Series instruments can report and log a wide range of alarm conditions, including:

- Input signal or external reference signal missing or format mismatch
- Color gamut errors
- EAV/SAV missing or mismatch with line number
- SAV placement error
- CRC and EDH errors, code word violations, or field and line length errors
- Ancillary data and closed caption present/absent errors, parity errors, or checksum errors

Every WFM700 model maintains an event log with each entry stamped with the time-of-day the event occurred. You can also configure event logging to time stamp events with a VITC value.

Convenient User Interface Features and Display Modes

WFM700 waveform monitors offer many convenient user interface features and display modes, including:

- An integrated thin-film LCD color display with touch screen
- Full-screen and thumbnail picture display
- Multi-mode display capability that lets you flexibly combine two displays into a single, split-screen view
- Freeze mode for comparing live signals against a stored reference
- Electronic graticules and digital cursors
- Safe action and safe title graticules that help you easily identify incorrectly positioned video content
- Up to 42 stored presets
- Print screen capability, context sensitive on-line help, and complete instrument diagnostics

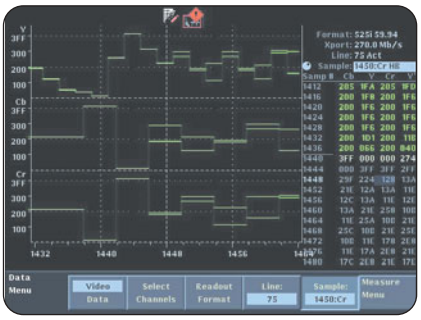
Video monitors and television sets may overscan, i.e., placing parts of the image outside the display area. Incorrect placement of graphics, logos, and other branding elements can obscure text or essential action. The Safe Action and Safe Title graticules help you quickly assure that the action and titles you produced lie within the safe areas defined in SMPTE RP218. The Safe Action Area is the maximum image area within which all significant action shall be contained while the Safe Title Area is the maximum image area within which all significant titles should be contained.

Powerful Digital Video Waveform Measurement Available

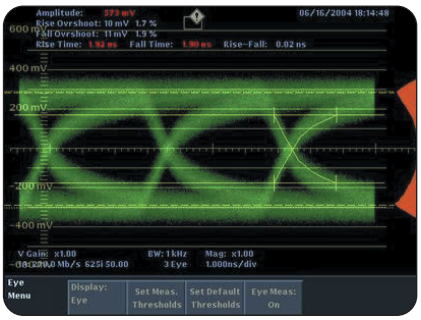
For in-depth technical measurement of digital video signals, you need additional capabilities. For making highly precise inter-channel amplitude and timing measurements, every WFM700 model offers the familiar Bowtie display. The WFM700M offers more comprehensive measurement capability, adding the following displays to those offered on the WFM700A and WFM700HD:

- Data display
- Eye pattern display
- Jitter display

The automated Eye measurements include amplitude, rise time, fall time, rise overshoot, fall overshoot and a histogram of the Eye sample amplitude values. In Jitter Display mode, the WFM700M demodulates the signal jitter, displays a trace of video-correlated jitter vs. time, and measures peak-to-peak time jitter in the active display.



▶ *WFM700 Data display.*



▶ *WFM700 Eye Pattern display.*

▶ *WFM700 5.1 multi-channel Surround Sound display.*

Digital Audio Monitoring Available on All Models

All members of the WFM700 Series detect and report the presence or absence of embedded audio channels. You can add more extensive capability for monitoring AES/EBU digital audio channels by including Option DG in your order for any WFM700 Series waveform monitor. You can add this audio monitoring capability to a previously purchased WFM700 model by ordering the WFM7DG field upgrade.

WFM700 Series digital audio monitoring and measurement features include:

- Monitoring of up to 16 embedded digital audio channels
- 4 AES/EBU audio inputs/outputs for monitoring up to 8 non-embedded audio channels, or producing up to 8 channels of de-embedded audio output
- Support for multi-channel digital audio in 5.1 and 7.1 formats
- Audio Level Bar display of 2, 4, 6, or 8 audio channels with true peak, PPM, and Extended VU meter ballistics and selectable scaling
- Single-axis Phase Correlation Meter showing the phase relationship between signals on an audio channel pair
- Flexible Lissajous display showing the phase relationship between channels, with X/Y or Sound Stage (L/R) axis orientation and automatic gain control
- Surround Sound Display for 5.1 multi-channel digital audio format with total volume, center volume, phantom source and dominant sound indicator as well as L_S and R_S correlation meter

Surround Sound Display helps you more precisely mix, master, edit and verify 5.1 multi-channel digital audio. The visual representation of the sound image complements your auditory experience.

The display shows the audio level balance among the left (L), right (R), left-surround (L_S), and right-surround (R_S) channels on the ruled scales radiating from the center. A vertical bar between the L and R channels shows the center (C) channel audio level.

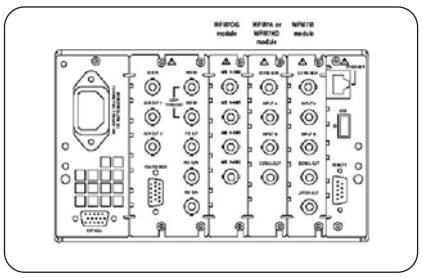
The polygon formed by connecting the level indicator endpoints shows the total sound volume formed by the L, R, L_S, and R_S channels. This connecting line will bend away from the center if the two signals have a positive correlation, will bend towards the center if the signals have a negative correlation, and will not bend if the signals have no correlation. In addition to this total volume indicator, the display has a separate center volume indicator by connecting the ends of the L, C, and R channel level by straight lines.

Phantom source indicators (PSIs) located on each side of the display show the location of potential phantom sound sources formed by adjacent channels.

The display also has a cross-hair pointer that shows the location of the dominant sound in the sound image, and a correlation meter at the bottom of the display that shows the correlation between the Ls and Rs channel.

The audio monitoring module supports the embedded and AES/EBU formats shown in the following table:

Audio Standard	Physical Interface	Sampling Frequency	
		48.0 kHz	44.1 kHz
AES3-1992 (r1997)	AES-3id-2001	X	X
AES3-1992 (r1997)	SMPTE 259M	X	
AES3-1992 (r1997)	SMPTE 292M	X	



▶ *WFM700 Back Panel with two WFM700M video input modules and an audio input module installed.*

Complementing these standard displays, the Channel Status display decodes the information in the Channel Status block defined in AES3-1992 (r1997) for both consumer-grade and professional-grade audio.

Audio monitoring support adds several alarm conditions to the list of video alarms described earlier, including detection of:

- Audio CRC errors
- Clip, mute, over, and silence conditions
- Audio parity errors
- Embedded audio absence and AES audio unlock

Like the session display used to monitor video signals, all WFM700 models with audio monitoring capability offer an Audio Session screen that lets you quickly check the health of any digital audio channels and track key audio signal parameters. Key fields include:

- Highest true peak, highest uninterpolated peak, and highest bar reading
- Sample rate and active bits
- The number of clips, mutes, overs, and silences
- Invalid samples
- Detected receiver errors

Multiple Inputs/Outputs for Easy System Integration

In addition to the inputs and outputs described earlier, every WFM700 model has the following connections:

- VGA output for viewing the LCD display on a detached VGA monitor
- Analog component video picture monitor outputs
- VGA picture monitor output that follows the component picture monitor output for viewing the picture on an inexpensive VGA display
- Looping inputs for bi-level and tri-level sync
- One switched SDI output that follows the selected input
- An SD SDI picture monitor output

Network Access and Control

The WFM700 Series offers two forms of remote access and control:

- A 9-pin remote control port reports alarm conditions and lets you control the monitor by selecting one of seven available instrument presets
- A network remote control interface lets you view the WFM700 displays using a standard Web-browser over an Ethernet-based network
- SNMP (Simple Network Management Protocol) speeds development and integration of remote control software for external control and reporting of major functions of the WFM700, including all error alarms

▶ Characteristics

Serial Digital Video Interface

Video Inputs – 2 per card – only one active at a time.

Input Type – 75 Ω BNC, internally terminated.

Launch Amplitude Accommodation –
800 mV ±10% for full specification.
800 mV ±30% up to 20 dB cable attenuation.

Jitter Tolerance – 0.4 UI_{p-p} typical above 2 MHz.

Return Loss – 15 dB to 1.5 GHz.

Isolation Between Inputs – >45 dB to 1 GHz.

Switched Serial Video Output

Format – 1.485 Gbps or 270 Mbps repeat of selected input.

Output Level – 800 mV_{p-p} ±5% into 75 Ω load.

Return Loss – 15 dB to 1.5 GHz.

Output Type – 75 Ω BNC.

External Reference

Sync Format – NTSC, PAL, 1080i 50 Hz, 1080i 59.94 Hz, 1080i 60 Hz, 720p 59.94 Hz, 1080p 23.98 Hz, 1080p 24 Hz.

Input Type – 75 Ω BNC passive loop.

Return Loss – 40 dB to 30 MHz.

Hum – Operates with 500 mV_{p-p}.

Signal/Noise – Operates to 25 dB.

Serial SD Only Monitor Output

Content Follows Active Input With Brightups – SD only digital version of RGB/Y'P'bP'r analog pix monitor output on Ref board.

Rate – 270 Mbps.

Signal Level – 800 mV ±5% into 75 Ω.

Return Loss – 20 dB, 5 MHz to 270 MHz.

Output Type – 75 Ω BNC.

Picture Monitor Outputs

Signal Format, BNC Outputs – Y, P'b, P'r with sync on Y, RGB with sync on all, HD and SD. HD sync is tri-level.

Signal Format, VGA D-sub Outputs – Same signal as on BNC outputs, also have TTL H and V drive.

Impedance – 75 Ω unbalanced.

Active Video Accuracy – 700 mV ±5%$_{p-p}$ (Y'P'bP'r mode).

Black (Blanking) Output Level – 0 mV ±25 mV for HD and SD.

Frequency Response, SD – Y, G, B and R ±5% to 5.5 MHz.

Frequency Response, HD – Y, G, B and R ±8% to 30 MHz.

AES Audio Interface

Audio Inputs – 4 inputs, 8 audio channels, meets Requirements of AES-3id-2001.

Input Type – 75 Ω BNC, internally terminated, unbalanced.

Input Amplitude Range – 0.2 V to 2 V_{p-p}.

Input Sample Rate – 32 k to 96 k samples/sec.

Input Lock Range – >±5%, typical.

Input Return Loss – Better than 25 dB from 0.1 to 6 MHz.

Audio Outputs – Up to 8 audio channels from Embedded Audio only.

Output Format – 48 kHz, 20 bit, meets requirements of SMPTE 276M-1995 (AES-3id-2001).

Output Amplitude Range – 0.9 V to 1.1 V_{p-p} into 75 Ω.

Output Sample Rate – Locked to embedded sample rate (nominally 48 kHz).

Output Jitter – Meets AES3-1997.

Output Return Loss – Better than 25 dB 0.1 to 6 MHz.

Waveform Vertical Deflection

Vertical Measurement Accuracy Using Graticule or Cursor –
At 1x, ±0.5% of 700 mV full scale.
At 5x, ±0.2% of 700 mV full scale.
At 10x, ±0.1% of 700 mV full scale.
Gain – 1x, 5x, 10x, variable.
Variable Gain Range – 0.25x to 14x.
Frequency Response, HD*[1] –
Luminance channel (Y): 50 kHz to 30 MHz ±0.5%.
Chrominance channels (P'b, P'r): 50 kHz to 15 MHz ±0.5%.

*[1] For monochrome signals, R, G and B bandwidths equal Y bandwidth.

Waveform Horizontal Deflection

Sweep Accuracy – ±0.5%, all rates, fully digital system.

Sweep Linearity – 0.2% of time displayed on screen, fully digital system.

Rates – 1, 2, 3, 4 line or field, depending on mode.

Line Select – Selected line in 1 line, selected first line in 2 line or parade.

Eye Pattern Display

Type – Equivalent time sampler.

Signal Bandwidth – 50 kHz to 2.5 GHz at –3 dB point.

Timebase Jitter – (Note: in 1 kHz high pass filter)
(HD) – 70 ps, typical.
(SD) – 150 ps, typical.

Eye Clock Bandwidth Accuracy – Actual –3 dB point within 10% of nominal.

Display Modes, SD –
Overlay: Overlays all bits to form each eye opening. Useful for observing peak jitter.
10 Eye: Displays eye relative to the parallel clock and line sync. Useful for observing jitter correlated to line rate and word clock.

Display Modes, HD –
Overlay: Overlays all bits to form each eye opening. Useful for observing peak jitter.
20 Eye: Displays eye relative to the parallel clock and line sync. Useful for observing jitter correlated to line rate and word clock.

Jitter Display

Type – Demodulated recovered clock per SMPTE RP184.

Digital Readout – Accuracy: <0.05 UI + 10%, typical, of reading for jitter frequencies from three times high-pass filter selection to 1 MHz.
Note: High-pass filter selection is set in Jitter Waveform Mode.

Jitter Waveform Gain Error – <0.1 UI + 10%, typical, of reading for jitter frequencies from three times high-pass filter selection to 1 MHz.

Jitter Waveform High-pass Filter Selection – 10 Hz, 1 kHz, 10 kHz, 100 kHz.

Jitter Output – 100 mV/UI, ±10% into 75Ω load.

Jitter Frequency Response – –3 dB at 5 MHz (typical).

RGB Gamut Error Detection

Detection Level –
High Limit, +630 mV to +756 mV in 1 mV steps.
Low Limit, –50 mV to +35 mV in 1 mV steps.

Arrowhead (NTSC/PAL Composite Gamut Limit Display Mode)

Detection Level –
Accuracy, ±7 mV.
Luma+Chroma High Limit (NTSC-derived formats), 90 IRE to 135 IRE in 1 IRE steps.
Luma+Chroma Low Limit (NTSC-derived formats), –50 IRE to –10 IRE in 1 IRE steps.
Luma+Chroma High Limit (PAL-derived formats), 630 mV to 950 mV in 1 mV steps.
Luma+Chroma Low Limit (PAL-derived formats), –400 mV to –100 mV in 1 mV steps.
Luma only High Limit, 90% to 108% in 1% steps.
Luma only Low Limit, –6% to +5% in 1% steps.

Audio Level Meter

Level Meter Resolution – 0.05 dB steps at 10 dB scale, from full scale to –40 dB FS.
0.25 dB steps at 0 to –70 dB scale, for signals above –40 dB FS.

Level Meter Accuracy –
0.2 dB from 20 Hz to 20 kHz with 0 to –40 dB FS sine-wave input. PPM Ballistic mode except within 7 Hz of some submultiples of the 192 kHz oversampling frequency. For example:
13.714 kHz ±7 Hz – 0.22 dB.
16.0 kHz ±7 Hz – 0.30 dB.
19.2 kHz ±7 Hz – 0.43 dB (worst case).

General Specifications

Power

Mains Voltage Range – 100 to 240 VAC ±10%.

Mains Frequency – 50 or 60 Hz.

Power Consumption (typical) –
≤100 W with 1 Video Input Module.
≤125 W with 2 Video Input Modules.
150 W max.

VGA O/P – This connector allows the front panel display to be replicated on a remote VGA monitor.

Ethernet Connector – Allows the instrument to be connected to a 10/100Base-T Ethernet circuit for remote control and firmware update.

Environmental

Temperature –
0 ºC to +40 ºC (operating).
–20 ºC to +60 ºC (nonoperating).

Humidity – 20% to 80% RH at up to 40 ºC, noncondensing (operating).

Altitude –
to 3,000 m (operating).
to 12,192 m (nonoperating).

Safety

Designed and tested for compliance with: ANSI/ISA s82.02.01, Can/CSA C22.2 No. 1010.1, IEC 61010-1, UL 3111-1, 93/68/EEC and EN 61010-1.

EMI

Tested for compliance with:

- ▶ FCC, CFR Title 47, part 15, Subpart B, Class A
- ▶ EN 55103-1/2, Class B emissions
- ▶ European EMC directive, video standard

Physical Characteristics

Dimensions	mm	in.
Height	133.4	5.25
Width	215.9	8.5
Depth	460.4	18.125
Weights	**kg**	**lb.**
Net	5.5	12.125
Shipping (approx.)	9.6	21.164

Multi-format, Multi-standard Waveform Monitors

▶ WFM700HD • WFM700A • WFM700M

▶ Ordering Information

The following models complete with one video input module (two video inputs).

Instruments

WFM700HD
SMPTE 292M Serial Digital Waveform Monitor.

WFM700A
ITU-R BT.601 and SMPTE 292M Serial Digital Waveform Monitor.

WFM700M
ITU-R BT.601 and SMPTE 292M Serial Digital Waveform Monitor with additional video measurements.

Optional Modules

Options installed and tested at time of manufacture. Maximum of two video modules and one audio module in an instrument.

Option 2HD – Serial digital monitoring module for SMPTE 292M.

Option 2A – Serial digital monitoring module for ITU-R BT.601 and SMPTE 292M.

Option 2M – Serial digital measurement module for ITU-R BT.601 and SMPTE 292M.

Option DG – AES/EBU digital audio monitoring module.

Power Plug Options

Opt. A0 – North America power.

Opt. A1 – Universal EURO power.

Opt. A2 – United Kingdom power.

Opt. A3 – Australia power.

Opt. A5 – Switzerland power.

Opt. A6 – Japan power.

Opt. AC – China power.

Accessories

Opt. 01 – Portable cabinet.

Opt. 02 – Dual rackmount.

Service

Opt. C3 – Calibration Service 3 Years.

Opt. D1 – Calibration Data Report.

Opt. D3 – Calibration Data Report 3 Years (with Option C3).

Opt. R3 – Repair Service 3 Years.

Language

Opt. L0 – English user manual.

Opt. L5 – Japanese user manual.

Opt. L9 – Korean user manual.

Field Upgrade Kits

Shipped as a kit and installed in the field. Maximum of two video modules and one audio module in an instrument.

WFM7HD – Serial digital monitoring module for SMPTE 292M.

WFM7A – Serial digital monitoring module for ITU-R BT.601 and SMPTE 292M.

WFM7M – Serial digital measurement module for ITU-R BT.601 and SMPTE 292M.

WFM7DG – AES/EBU digital audio monitoring module.

Opt. IF – Upgrade Installation Service.

Optional Accessories

WFM7F02 – Portable cabinet includes handle, feet, tilt bail and front panel cover.

WFM7F03 – Plain cabinet.

WFM7F05 Opt. ON or Opt. NN – Dual rackmount for 1700 Series, WFM601 Series, WFM700 Series, 760A and 764.

071-0915-xx– Service Manual for WFM700 Series products (WFM700HD, WFM700A and WFM700M).

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Tektronix
Enabling Innovation

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Tektronix Announces New Family of Multi-format, Modular Waveform Monitors

New Platform Addresses Customer Need for Standard-Definition/High-Definition Monitoring/Measurement

LAS VEGAS (National Association of Broadcasters Convention), April 23, 2001 -Tektronix, Inc. (NYSE: TEK), the market leader in the manufacture of waveform monitors for the video industry, today broadened its video product portfolio with the introduction of a new family of flexible, multi-format waveform monitors which addresses the growing market of digital signal monitoring and measurement requirements, including those for high-definition broadcasting and content creation.

Digital technology requires the monitoring and measurement of both high-definition (HD) and standard-definition (SD) serial digital video signals. The new Tektronix WFM700 family measures and monitors HD and SD digital signals in the same cost-effective, modular platform. The WFM700 is based on a new platform which utilizes full digital processing and comes with an integrated touchscreen color display which is 50% larger than traditional CRTs but maintains the high display quality associated with CRTs.

Waveform monitors provide feedback on the fidelity of a video signal. They are the primary tools used for performance monitoring and maintenance of video systems and video equipment in post-production facilities, broadcast operations, and manufacturing plants.

"Tektronix has a strong heritage of providing the world's most functional waveform monitors," said Bob Agnes, vice president, Video Business Unit, Tektronix, Inc. "Today's introduction of the WFM700 family strengthens our position in the video test, measurement, and monitoring market space by offering customers an extremely flexible, future-proof platform which addresses multiple customer needs. The WFM700's architectural design assures customers that the purchase they make today will accommodate their needs tomorrow by allowing them to purchase only the modules they currently require with the assurance that they can acquire additional modules as their needs change."

About the Product

The Tektronix WFM700 family of waveform monitors is an easy-to-use, multi-standard, multi-format, modular monitoring/measurement platform in a traditional half rack width package which provides space and cost savings over individual products required to support individual standards. Its multiple display options, including industry-standard Vector, Diamond, and Arrowhead displays currently used in the industry-leading Tektronix WFM601 and WFM1125 products lines, and typical Waveform and data displays, simplify the task of ensuring legal and valid signals and facilitate system design and integration. Other features include HD and SD eye-pattern measurements and jitter measurement displays. Ethernet connectivity enhances serviceability by providing software upgrades to capture changes in the environment such as new formats.

By virtue of its digital signal processing, the WFM700 provides reliable and repeatable measurements of HD and SD video formats. The monitor can be set-up to accept HD or SD signals through the same input. The integrated color display with touchscreen capabilities provides operators with a quick and easy way to recognize problems that degrade the quality of a broadcast. A user-friendly interface, auto detection of input video and reference signal, and other features make the WFM700 the ideal tool for integration into evolving systems.

Based on a modular platform to provide flexibility and upgradability, the WFM700 family is currently available with three modules: an HD monitor input module, an HD/SD monitor input module, and an HD/SD measurement input module with eye pattern and jitter measurements.

About the Applications

The WFM700 will find a home in traditional broadcast, production and post-production facilities and in video equipment manufacturing plants. Traditional broadcasters will use the WFM700 family to analyze signals for standards compliance and for confidence monitoring of digital television (DTV) services in master control, transmission, and production areas. Production and post-production facilities working in multi-format environments will use the new waveform monitor for camera shading and alignment, to monitor color correction and analyze color for film-to-tape transfer, and to check gamut for quality control. Equipment manufacturers will use the product for equipment research and design.

About Tektronix

Tektronix, Inc. is a test, measurement, and monitoring company providing measurement solutions to the telecommunications, computer, and semiconductor industries worldwide. With more than 50 years of experience, Tektronix enables its customers to design, build, deploy, and manage next-generation global communications networks and Internet technologies. Headquartered in Beaverton, Oregon, Tektronix has operations in 26 countries worldwide. Tektronix' Web address is www.tektronix.com.

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Specifications

The following tables list the specifications for the Tektronix WFM700 Standard Definition/High Definition Multiformat Video Waveform Monitor. Items listed in the Performance Requirement column are generally quantitative, and can be tested by the *Performance Verification* procedure in the *WFM700 Series Service Manual*. Items listed in the Reference Information column are useful operating parameters that have typical values; information in this column is not guaranteed.

The specifications listed in the Electrical Specifications portion of these tables apply over an ambient temperature range of +0 °C to +40 °C. The rated accuracies are valid when the instrument is calibrated in an ambient temperature range of +20 °C to +30 °C.

Electrical Specifications

Table 1-4: Waveform vertical deflection

Characteristic	Performance requirement	Reference information
Vertical Measurement Accuracy, YPbPr		Limited by the screen resolution and internal processing. Fully digital system.
1X	±0.5% of 700 mV full scale mode	
5X	±0.2% of 700 mV full scale mode	
10X	±0.1% of 700 mV full scale mode	
Gain	X1, X5, and X10	
Variable Gain Range, Typical		0.25X to 14X
Frequency Response - HD		
Luminance Channel (Y)	50 kHz to 30 MHz, ±0.5%	
Chrominance Channels (Pb, Pr)	50 kHz to 15 MHz, ±0.5%	
Frequency Response - SD		
Luminance Channel (Y)	50 kHz to 5.75 MHz, ±0.5%	
Chrominance Channels (Pb, Pr)	50 kHz to 2.75 MHz, ± 0.5%	
YPbPr to RGB Conversion Accuracy		0.35%, nominal

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Table 1-4: Waveform vertical deflection (Cont.)

Characteristic	Performance requirement	Reference information
Step Response, Typical		Sine-squared bars
Preshoot		
SD		≤ 0.3% peak (2T5 bar)
HD		≤ 0.5% peak (2T30 bar)
Overshoot		
SD		≤ 0.3% peak (2T5 bar)
HD		≤ 0.5% peak (2T30 bar)
Ringing		
SD		≤ 0.4% peak-peak (2T5 bar)
HD		≤ 0.8% peak-peak (2T30 bar)
		Most of the error seen on the display comes from the inherent ringing in the digital data. The response of the WFM700 is close to the theoretical limit of a perfect sinx/x reconstruction filter.
Pulse Response, Typical		Blackman pulse
Baseline Ringing		
SD		≤0.6% peak-peak (2T5)
HD		≤0.7% peak-peak (2T30)
		Pulse-to-bar ratio 0.995:1 to 1.005:1 on appropriate Sine Squared or Blackman 2T pulse.
		A sine-squared pulse near Nyquist is not band-limited and so inherently has ringing much larger than the WFM700 filter. A three term Blackman pulse with the same HAD has much less inherent ringing, so it is a better choice for most testing. See Digital to Analog Conversion, Data and Filter Requirements, SMPTE Journal Mar 1995, Vol. 104, Fibush, Baker, Penny.

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Table 1-4: Waveform vertical deflection (Cont.)

Characteristic	Performance requirement	Reference information
Interpolation Filter Group Delay, Typical		
HD		1 ns
SD		1 ns
Tilt, Typical		
Field Rate		0.1%
Line Rate		0.1%
Off Screen Recovery, Typical		0.1% variation in baseline of a 5 MHz modulated pulse when positioned anywhere on screen
Offset, Typical		Pr and Pb can be displayed aligned to Y or offset by 350 mV.

Table 1-5: Waveform horizontal deflection

Characteristic	Performance requirement	Reference information
Sweep		
Accuracy	± 0.5%, all rates	Fully digital system
Linearity	0.2% of time displayed on screen	Fully digital system
Timing Cursor Registration and Readout Accuracy, Typical		± 0.5% of sweep time displayed on screen
Rates		1, 2, 3, or 4 line or field depending on mode.
Line Select		Selected Line in 1 Line Selected first line in 2 Line or Parade

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Table 1-6: Eye pattern display

Characteristic	Performance requirement	Reference information
Type		Equivalent Time Sampler
Signal Bandwidth	50 KHz to 2.5 GHz at -3 dB point	
Time Base Jitter		
SD		150 ps p-p in 1 kHz high-pass filter mode
HD		70 ps p-p in 1 kHz high-pass filter mode
Eye Clock Recovery Bandwidth Settings		Clock recovery bandwidth can be set to 10 Hz, 100 Hz, or 1000 Hz high pass filter
Eye Clock Recovery Bandwidth Accuracy	Actual -3 dB frequency within 10% of nominal	
Jitter Attenuation Error		
10 Hz or 100 Hz Bandwidth	<10% for frequencies greater than 2 times the Clock BW setting	
1 kHz Bandwidth	<-10%, +20% for frequencies from 2 KHz to 10 kHz; <10% for frequencies above 10 kHz	
Display Modes		
SD		
Overlay		Overlays all bits to form each eye opening. Useful for observing peak jitter.
10 Eye		Displays eye relative to the parallel clock and line sync. Useful for observing jitter correlated to line rate and word clock.
HD		
Overlay		Overlays all bits to form each eye opening. Useful for observing peak jitter.
20 Eye		Displays eye relative to the parallel clock and line sync. Useful for observing jitter correlated to line rate and word clock.
Deflection Factor		
Vertical	800 mV ±5% with an 800 mVp-p input signal	
Horizontal		±1%, fully digital system

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Table 1-7: Jitter display

Characteristic	Performance requirement	Reference information
Type		Demodulated recovered clock, per SMPTE RP184 specifications.
High-Pass Filter Settings		Can be set to 10 Hz, 1 kHz, 10 kHz, or 100 kHz. Applies to digital readout, jitter waveform, and jitter output.
High-Pass Filter Attenuation	-2 dB to -4 dB at specified frequency.	Applies to digital readout, jitter waveform, and jitter output.
High-End Frequency Response, Typical		-3 dB at > 5 MHz. Applies to digital readout, jitter waveform, and jitter output.
Dynamic Range, Typical Maximum is a function of jitter frequency and standard:		Applies to digital readout, jitter waveform, and jitter output.
10 Hz to 50 kHz, HD		9 UI_{p-p}
10 Hz to 50 kHz, SD		7 UI_{p-p}
100 kHz to 5 MHz		Decreasing linearly to 0.2 UI_{p-p} at 5 MHz
Minimum (noise floor) is a function of high-pass filter selection:		
10 Hz, HD		60 ps typical
1 kHz, 10 kHz, HD		60 ps typical
100 kHz, HD		30 ps typical
All HPF settings, SD		200 ps typical
Digital Readout Type		Indicates timing jitter or alignment jitter, depending on high-pass filter selection.
Digital Readout Error, Typical		< 0.05 UI, +10% of reading for jitter frequences from 3 times high-pass filter selection to 1 MHz.
Resolution		0.01 UI
Jitter Waveform Gain Error, Typical		< 0.1 UI +10% for jitter frequencies from 3 times high-pass filter selection to 1 MHz
Scale Horizontal Modes		1 Line, 2 Line, 1 Field, 2 Field
Vertical Modes		1 UI / div, 0.2 UI / div, 0.1 UI / div
Jitter Output		100 mV / UI, ±10%, into 75 Ω load. In Jitter Mode only

Table 1-8: Component Vector mode

Characteristic	Performance requirement	Reference information
Vertical Bandwidth, Typical		
SD		1.2 MHz
HD		4.5 MHz
Vertical Gain Accuracy	± 0.5%	Fully digital system
Horizontal Gain Accuracy	± 0.5%	
Display to Graticule Registration	0.5%	Fully digital system limited by sample resolution
Vector Display		P_B is displayed on horizontal axis and P_R is displayed on vertical axis

Table 1-9: Lightning and Diamond modes

Characteristic	Performance requirement	Reference information
Vertical Gain Accuracy	±0.5%	Fully digital system
Electronic Graticule Display		
Diamond		RGB deflection axis indicated
Split Diamond		Offsets the top and bottom diamonds horizontally for better viewing of black gamut space.
Lightning		Displays signal components as follows: Y vertically Pb horizontally on top half of display P_r horizontally on bottom half of display

Table 1-10: Data display mode

Characteristic	Performance requirement	Reference information
Digital Waveform		Non-interpolated waveform display. Cursor identifies selected sample value (hex, decimal, binary). Cross-hair cursor inserted on picture monitor output shows selected line and sample.
Digital List		Sequential list of sample values in table format. Cursor identifies selected sample.
Display Format		HEX, DEC, BIN

Table 1-11: Arrowhead mode (NTSC/PAL composite limit display)

Characteristic	Performance requirement	Reference information
Signal to Graticule Accuracy	±1%, 100 IRE (700 mV), and 131 IRE	(PAL values in parenthesis)
Composite Limit Cursor Accuracy	±0.5% at 100 IRE, 110 IRE, 120 IRE, and 131 IRE (700 and 950 mV)	(PAL values in parenthesis)
Composite Limit Detection Level Accuracy	Detection level ±7 mV 90% to 135% in 1% steps	

Table 1-12: Bowtie mode

Characteristic	Performance requirement	Reference information
Common Mode Rejection Ratio		
SD	≥34 dB at 2.5 MHz	With SD 2.5 MHz, 350 mV Bowtie test signal. Null amplitude measured with cursors at 10x gain.
HD	≥40 dB at 5 MHz	With HD 5 MHz, 700 mV Bowtie test signal. Null amplitude measured with cursors at 10x gain.
Interchannel Timing Match		
SD	±0.5 ns	With SD 2.5 MHz, 20 ns markers Bowtie test signal. In H MAG, null within 0.5 division of center marker.
HD	±0.1 ns	With HD 5 MHz, 1 ns markers Bowtie test signal. In H MAG, null within 0.5 division of center marker.

Table 1-13: Freeze/Capture function

Characteristic	Performance requirement	Reference information
Delay Time from Button Push		< 3 frames at input frame rate
Saved Capture Size		1 frame at VGA display rate
Number of Captures		1

Table 1-14: Data error detection (EDH / Status)

Characteristic	Performance requirement	Reference information
Reporting Means		Data errors shown in Video Status/Session and Alarm Status displays. On-screen notification, audible beep, logging, and ground-closure remote output can also be enabled through the Configure menu.
Data Integrity		
SD	Both active picture and full field checks. Field rate resolution. Complies with SMPTE RP165.	Indicates CRC check-word errors for signals including EDH (Error Detection and Handling).
HD	Both Y and Color Difference checks. Field rate Resolution.	
Error Statistics		Indicates errored fields, % errored fields, and asynchronous errored seconds. Active picture and full field statistics are compiled separately.
Ancillary Data		Indicates the presence of ancillary data (other than audio and EDH) and indicates parity or checksum errors.
Bit Activity		Indicates if any of the 10 data bits are stuck high or low during the active picture of an entire field.
Signal Format		Indicates bit rate and detected format.
Format Errors		Indicates serial signal format errors. Detected Errors: SAV placed incorrectly relative to EAV Line length error Field length error SDI code word violation 292M line mismatch (HD only)
Input Signal Unlocked		Indicates input unlocked due to degraded, missing or inappropriate input signal.

Table 1-15: RGB GAMUT error detection

Characteristic	Performance requirement	Reference information
Detection Level		
High Limit	+630 mV to +756 mV in 1 mV steps	
Low Limit	-50 mV to +35 mV in 1 mV steps	
Detection Level Accuracy	±3.5 mV	

Table 1-16: Closed caption detection

Characteristic	Performance requirement	Reference information
Detected Formats		Any selected video input; detects presence of EIA 608, EIA 708, and ARIB STD-B37 Closed Captioning
Decoded Formats		EIA 608 (VBI) EIA 608 (ANC) EIA 608 (708)
EIA/Line 21 (VBI) Line Detection Range		
Auto Detect		Lines 11 to 25
Manual Detect		Lines 5 to 25

Table 1-17: Timecode decoding

Characteristic	Performance requirement	Reference information
Sources		Any selected video input
SD		Extracts and decodes VITC (SMPTE 12M)
HD		Extracts and decodes VITC (SMPTE 12M) and ancillary timecode (SMPTE RP188)

Table 1-18: Audio mode (without Option DG)

Characteristic	Performance requirement	Reference information
Embedded Audio		Identifies the presence of up to 16 channels of AES/EBU digital audio. Presence is detected by looking at AES protocol.

Table 1-19: Audio alarms (Option DG only)

Characteristic	Performance requirement	Reference information
Audio Level Alarms		Warns of mute, clip, silence or over condition on an audio channel
Audio Error		Warns of CRC and parity errors and of validity bit set
Audio Unlocked		Warns of unlocked condition on an AES input
Group Sample Phase		Warns of sample phase errors between the two selected embedded audio groups

Table 1-20: Audio level meter displays (Option DG only)

Characteristic	Performance requirement	Reference information
Bar Modes		The user can configure the response dynamics (ballistics), reference levels, peak hold, and scale of the meters to suit the monitoring needs of the particular installation or situation. Each pair has a phase correlation meter.
Stereo Pairs		All 4 channel pairs with phase correlation meters
Surround		8 channels (L, C, R, Ls, Rs, LFE, Lo, Ro) with phase correlation meters for L & R, Ls & Rs, and Lo & Ro.
Audio Sources		Monitoring the signal levels and stereo phase of AES/EBU digital audio or digital audio embedded in serial digital video
Level Meter Resolution		0.05 dB steps at 10 dB scale, for from full scale to -40dB FS 0.25 dB steps at 0 to -70 dB scale, for signals above -40 dB FS
Metering Ballistics		Selectable from true peak, PPM, and Extended VU
Peak Program Meter		Per IEC 268-10A and IEEE std. 152-1991
True Peak		PPM decay characteristics, no attack delay
Extended VU		VU meter as defined in IEEE 152-1991, but with an extended dB-linear scale
Peak Hold		True peak indicator remains at the most recent peak for user selectable time of 1 to 10 seconds
Clip Indication Delay Count		Consecutive FS samples for Clip Indication, user selectable Off or 1 to 100 Only the 16 most significant bits are checked for 0x7FFF or 0x8000 to identify a full-scale sample
Mute Indication Delay Count		Consecutive “0” samples for Mute Indication, user selectable Off or 1 to 100
Clip/Mute Hold Time		1 to 30 seconds, user selectable

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Table 1-20: Audio level meter displays (Option DG only) (Cont.)

Characteristic	Performance requirement	Reference information
Silence Indication Threshold		Audio level below which the signal will be considered “silent.” User selectable from 0 dB FS to -90 dB FS. Used to trigger on-screen indication and alarms
Over Level Indication Threshold		Audio level above which the signal will be considered “over level.” User selectable from 0 dB FS to -90 dB FS. Used to trigger on-screen indication and alarms
Silence / Over Indication Delay		Off or 1 to 30 seconds, user selectable Indication and alarm will not be asserted until signal stays below silence threshold or above over threshold for this number of consecutive seconds
Adjustable Peak Program Level		Range 0 to -30 dBFS
Adjustable Test Level		Range 0 to -60 dBFS
Set 0 dB Mark		Selections are Digital Full-Scale (dBFS), Peak Program (dB), or Test Level (dB)

Table 1-21: Audio lissajous display (Option DG only)

Characteristic	Performance requirement	Reference information
Description		Lissajous display is available in combination with either Bar mode (see Table 1-20)
Axis Orientation		Selections are X-Y or Sound Stage (Sound Stage is rotated 45 degrees counterclockwise from X-Y)
Automatic Gain Control (AGC)		Automatic gain control may be on or off
Manual (Fixed) Scaling		When AGC is off, level at perimeter of display follows Peak Program Level on Bar display

Table 1-22: Audio session display (Option DG only)

Characteristic	Performance requirement	Reference information
Audio Session Display		Allows capturing of the following parameters. User can start, stop and reset the session.
Sample Frequency		Measured audio sample rate (approximate)
Invalid Data		Occurrence of AES samples with the validity bit set
Detected Receive Errors		Occurrence unlocked condition or AES samples with parity error
Active Bits		Identifies audio bits that are not always zero. Indicates 16, 20 or 24. 16: 16 or fewer active bits 20: 17 to 20 active bits 24: 21 to 24 active bits
Highest True Peak		Peak value of interpolated input data. This gives the best representation of level in reconstructed audio program.
Highest Level Reading		Peak value using selected level meter ballistic
Highest Non-interpolated Peak		Peak value of digital input data. This gives the best representation of peak data values encountered by digital equipment.
Number of		
Clips		Total clips as defined in Table 1-20
Mutes		Total mutes as defined in Table 1-20
Overs		Total overs as defined in Table 1-20
Silences		Total silences as defined in Table 1-20
Time Since Reset		Elapsed time since the session was last reset

Table 1-23: Audio channel status display (Option DG only)

Characteristic	Performance requirement	Reference information
Channel Status		Decodes the AES channel status bits

Table 1-24: AES audio inputs (Option DG only) [1]

Characteristic	Performance requirement	Reference information
Inputs		4 inputs, 8 audio channels, meets requirements of AES-3id-2001
Input Connector		BNC, terminated, unbalanced
Input Impedance		75 Ω
Input Return Loss	>25 dB from 0.1 to 6 MHz	
Input Amplitude Range		0.2 V to 2 V peak-to-peak
Input Sample Rate	32k to 96k samples/sec	
Input Lock Range		> ± 5%. If input sample rate changes more than 5%, then the instrument may search again for a new lock point.
Level Meter Accuracy Over Frequency	0.2 dB from 20 Hz to 20 kHz with 0 to -40 dBFS sine wave input, PPM ballistic mode except for within 7 Hz of some submultiples of the 192 kHz internal over-sampling frequency. For example: 192/14 = 13.714 kHz + 7 Hz, (-0.22 dB) 192/12 = 16 kHz + 7 Hz, (-0.3 dB) 192/10 = 19.2 kHz + 7 Hz, (-0.43 dB)	May not display full amplitude on fast transients due to sampled nature of digital signal.

[1] The AES connectors can be configured for input or output functionality.

Table 1-25: AES audio outputs (Option DG only) [1]

Characteristic	Performance requirement	Reference information
Source		From embedded audio only
Number of Outputs		Up to 8 channels
Output format		48 kHz, 20 bit, meets requirements of SMPTE 276M-1995 (AES 3-ID)
Output Connector		BNC, terminated, unbalanced
Output Impedance		75 Ω
Output Return Loss	>25 dB from 0.1 to 6 MHz	
Output Amplitude	0.9 V to 1.1 V peak-to-peak into 75 Ω	
Output Sample Rate		Locked to embedded sample rate (nominally 48 kHz)
Output Jitter, Typical		Meets AES3-1997: <0.025 UI peak as measured with 700 Hz intrinsic jitter measurement filter

[1] The AES connectors can be configured for input or output functionality.

Table 1-26: Picture mode

Characteristic	Performance requirement	Reference information
Format		Picture can be viewed in all formats: In SD, full-size picture is cropped from 720 to 640 pixels wide. In SD, half-size picture is downsampled to fit into 360 x 240 size. In HD, picture is downsampled to fit into 640 x 480 size. In low frame rate formats, frames are repeated as needed to achieve VGA speed; this is similar to 3:2 pulldown on some frame rates.
Synchronization		Picture mode always uses internal timing. It is not affected by external sync.

Table 1-27: LCD display

Characteristic	Performance requirement	Reference information
Display Area		
Horizontal		13 cm
Vertical		10 cm
Resolution		640 (H) x 480 (V) pixels
Color Palette		6 bits per component. LSB is dithered to improve picture.
Pixel Defects	≤ 6 bad pixels	

Table 1-28: External VGA output (EXT VGA)

Characteristic	Performance requirement	Reference information
Content		Identical to front-panel LCD display
Output Levels		1 V for RGB signals, 3.3 V for H and V sync signals
Resolution		640 (H) x 480 (V) pixels
Color Palette		6 bits per component. LSB is dithered to improve picture.
Connector Pin Assignments		Pin 1: R Pin 6: GND Pin 11: NC Pin 2: G Pin 7: GND Pin 12: NC Pin 3: B Pin 8: GND Pin 13: HSync Pin 4: NC Pin 9: NC Pin 14: VSync Pin 5: GND Pin 10: NC Pin 15: NC

Table 1-29: Picture monitor outputs

Characteristic	Performance requirement	Reference information
Signal Format		
BNC outputs SD and HD		Y, Pb, Pr with sync on Y RGB with sync on all components. HD sync is tri-level.
VGA DSUB outputs		Same signals as on BNC outputs, also have TTL H and V drive.
DAC Resolution		10 bit
Impedance, Typical		75 Ω unbalanced
Active Video Accuracy, Y-Pb-Pr mode	700mV ±5% peak-to-peak	
Black (Blanking) Output Level SD and HD	0 mV ±25 mV	
Frequency Response, Typical		Response changes between systems with 1 video module and systems with 2 video modules installed. Response degrades if driving both BNC and VGA outputs.
SD		Y, G, B, and R ±5% to 5.5 MHz
HD		Y, G, B, and R ±8% to 30 MHz
Non-Linearity	≤0.5%	
Group Delay Error, Typical		
SD		±10 ns to 5.5 MHz
HD		±6 ns to 27 MHz
Interchannel Timing Match, Typical		
SD		Y-to-Pb and Y-to-Pr ±3.0 ns
HD		Y-to-Pb and Y-to-Pr ±4.0 ns
Sync Amplitude Accuracy, Typical		
SD		-300 mV ±5%
HD		300 mV on positive transition 400 mV on negative transition
S/N inband, Typical		
SD		60 dB to 5.5 MHz on quiet line RMS relative to 700 mV
HD		50 dB to 30 MHz on quiet line RMS relative to 700 mV
Return Loss on BNCs	>40 dB to 30 MHz	
Transcoder Accuracy		9 bit

Table 1-30: Serial SD only monitor outputs (SD PIX MON)

Characteristic	Performance requirement	Reference information
Content - Follows active input with brightups (SD Only)		Gamut brightups appear one line below error. Digital version of RGB/YPbPr analog pix monitor output on Ref board.
Rate		270 Mb/s
Signal Level	800 mV ± 5% into 75 Ω	Internal adjustment
Return Loss	>20 dB, 5 MHz to 270 MHz	

Table 1-31: Serial digital video interface

Characteristic	Performance requirement	Reference information
Video Inputs		Two per video module; only one input active at a time.
Format		Each input compatible with SMPTE 292M/BTA-S004B and 270 Mb/s SMPTE 259M
Input Type		75 Ω BNC, internally terminated
Cable Loss Accommodation	With 1/SQRT(f) characteristic at ½ of serial rate.	
SD	0 to 30 dB attenuation	Equivalent to approximately 300 m of Belden 8281 at 270 Mb/s, typically 400 m.
HD	0 to 20 dB attenuation	Equivalent to approximately 80 m of Belden 8281 at 1.485 Gb/s, typically 120 m.
Allowed Serial Source Amplitude		
With Max Specified Cable Loss		800 mV ± 10%
Up to 20 dB Cable Loss		800 mV ± 30%
Jitter Tolerance, Typical		0.4 UI p-p above 2 MHz. Increases proportional to 1/f below 2 MHz.
Return Loss	> 15 dB to 1.5 GHz	
Isolation Between Inputs	> 45 dB to 1 GHz	

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Table 1-32: Switched serial video output (serial out)

Characteristic	Performance requirement	Reference information
Format		1.485 Gb/s, 1.4835 Gb/s, or 270 Mb/s repeat of selected input. Functionally follows active input if on this input module.
Output Level	800 mV, ± 5% into 75 Ω load	
Return Loss	15 dB to 1.5 GHz	

Table 1-33: External reference

Characteristic	Performance requirement	Reference information
Operational		Locks to analog bi-level and tri-level signals of formats listed in *Supported Video Standards* starting on page 1-5. Reference must have a frame rate compatible with input. WFM mode and Line Select derive timing from the external sync information. Picture mode does not use timing from the external reference.
Analog Sync Format	PAL 1080i 60 Hz 720p 59.94 Hz NTSC 1080i 59.94 Hz 1080p 23.98 Hz 1080p 24 Hz	External reference is tested with PAL 1080i 60 Hz and 720p 59.94 Hz signals. This guarantees operation with all specified formats.
Input Signal Level, Typical		- 6 dB to + 6 dB
Maximum Operating Input Voltage, Typical		±15 V DC
Absolute Maximum Input Voltage, Typical		±15 V DC
Inband Input Impedance, Typical		≥ 15 KΩ
Return Loss	> 40 dB to 30 MHz	
Hum Tolerance, Typical		Operates with 500 mV_{p-p}
Signal/Noise Tolerance, Typical		Operates to 25 dB

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Table 1-34: Ethernet

Characteristic	Performance requirement	Reference information
IP Address Mode		Supports manual and DHCP
Printer Support		Prints to Postscript 2 format printers on TCP/IP network
Connector Type		RJ-45 LAN connector supporting 10/100 Base-T

Table 1-35: Remote port

Characteristic	Performance requirement	Reference information
Alarm Output		
Type		Open collector NPN switching transistor; Emitter grounded; Fused, 0.3 A
Maximum Voltage		-0.3 V, +15 V
Maximum Current		50 mA
Preset Inputs		
Type		Active high logic inputs
Maximum Voltage		±15 V
Input Resistance		3 kΩ to 5 kΩ to ground
Input Signal Requirements		Input high voltage: 2 V minimum Input low voltage: 0.8 V maximum
Connector Pin Assignments		Pin # Signal 1 Out; -10 V DC (not used) 2 Out; +10 V DC for pull-up use; typical source impedance: 750 Ω 3 In; TTL high, 15 V maximum [1] 4 In; TTL high, 15 V maximum [1] 5 Ground 6 Not used 7 In; TTL high, 15 V maximum [1] 8 Out; +10 V DC for pull-up use; typical source impedance: 750 Ω 9 Out; Active low when any enabled alarm condition occurs

[1] **Refer to Table 2-21 on page 2-127 for a listing of the instrument presets recalled using pins 3, 4, and 7 with ground closure.**

Table 1-36: Power source

Characteristic	Performance requirement	Reference information
Electrical Rating	100 - 240 VAC, 50/60 Hz, 175 Watts max.	Tested to 90 - 264 VAC, 50/60 Hz. 2.6 A max.
Supply Connection		Detachable cord set
Power Consumption, Typical		<150 VA (100 Watts) with 1 video module and 125 Watts with 2 video modules
Power Consumption, Option DG Maximum		13 Watts
Standby Power Consumption, Typical		1 Watt at 110 or 240 VAC
Surge, Typical		5 amps at 90 V 2.5 amps at 240 V
Fuse Rating	T3.5, 250 V	Not operator replaceable. Refer servicing to qualified service personnel.

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Physical Specifications

Table 1-37: Physical characteristics

Characteristic	Standard
Dimensions	
Height	5 1/4 inches (133.4 millimeters)
Width	8 1/2 inches (215.9 millimeters)
Depth	18 1/8 inches (460.4 millimeters)
Weight	
Net	12 pounds (5.5 kilograms)
Shipping	21 pounds (9.6 kilograms) approximate

Table 1-38: Environmental performance

Category	Standards or description
Temperature	
Operating	0 °C to +40 °C
Non Operating	-20 °C to +60 °C
Humidity	
Operating	20% to 80% relative humidity (% RH) at up to +40 °C, non-condensing
Non Operating	5% to 90% RH (relative humidity) at up to +60 °C, non-condensing
Altitude	
Operating	Up to 9,842 feet (3,000 meters)
Non Operating	Up to 40,000 feet (12,192 meters)
Cooling	Variable Fan. Forced air circulation with no air filter.
Required Clearances	Top None Bottom None Left side 2 in (51 millimeters) Right side 2 in (51 millimeters) Front None Rear 2 in (51 millimeters)

Certifications and Compliances

Table 1-39: Certifications and compliances

Category	Standards or description	
EC Declaration of Conformity - EMC	Meets the intent of Directive 89/336/EEC for Electromagnetic Compatibility. Compliance was demonstrated to the following specifications as listed in the Official Journal of the European Communities:	
	EN 55103	Product family standard for audio, video, audio-visual and entertainment lighting control apparatus for professional use.[2]
	Environment	E2 - commercial and light industrial
	Part 1 Emission	
	EN 55022	Class B radiated and conducted emissions
	EN 55103-1, Annex A	Radiated magnetic field emissions
	EN 55103-1, Annex B	Inrush current; I peak = 2.19 amps
	EN-55103-1, Annex E	Conducted emissions, signal/control ports
	Part 2 Immunity	
	IEC 61000-4-2	Electrostatic discharge immunity
	IEC 61000-4-3	RF electromagnetic field immunity
	IEC 61000-4-4	Electrical fast transient / burst immunity
	IEC 61000-4-5	Power line surge immunity
	IEC 61000-4-6	Conducted RF Immunity
	IEC 61000-4-11	Voltage dips and interruptions immunity
	EN 55103-2, Annex A	Radiated magnetic field immunity
	EN 55103-2, Annex B	Balanced ports common mode immunity
	EN 61000-3-2	AC power line harmonic emissions
Australia / New Zealand Declaration of Conformity - EMC	Complies with EMC provision of Radiocommunications Act per the following standard(s):	
	AS/NZS 2064.1/2	Industrial, Scientific, and Medical Equipment: 1992
FCC Compliance	Emissions comply with FCC Code of Federal Regulations 47, Part 15, Subpart B, Class A Limits.	
EC Declaration of Conformity - Low Voltage	Compliance was demonstrated to the following specification as listed in the Official Journal of the European Communities:	
	Low Voltage Directive 73/23/EEC, amended by 93/68/EEC	
	EN 61010-1:1993/A2:1995	Safety requirements for electrical equipment for measurement control and laboratory use.
U.S. Nationally Recognized Testing Laboratory Listing	UL3111-1	Standard for electrical measuring and test equipment.
Canadian Certification	CAN/CSA C22.2 No. 1010.1	Safety requirements for electrical equipment for measurement, control, and laboratory use.

[2] **Use only high-quality shielded cables.**

Table 1-39: Certifications and compliances (cont.)

Category	Standards or description	
Additional Compliance	IEC61010-1	Safety requirements for electrical equipment for measurement, control, and laboratory use.
	ISA S82.02.01:1999	Safety standard for electrical and electronic test, measuring, controlling, and related equipment.
Installation (Overvoltage) Category Descriptions	Terminals on this product may have different installation (overvoltage) category designations. The installation categories are:	
	CAT III	Distribution-level mains (usually permanently connected). Equipment at this level is typically in a fixed industrial location.
	CAT II	Local-level mains (wall sockets). Equipment at this level includes appliances, portable tools, and similar products. Equipment is usually cord-connected.
	CAT I	Secondary (signal level) or battery operated circuits of electronic equipment.
Pollution Degree Descriptions	A measure of the contaminates that could occur in the environment around and within a product. Typically the internal environment inside a product is considered to be the same as the external. Products should be used only in the environment for which they are rated.	
	Pollution Degree 1	No pollution or only dry, nonconductive pollution occurs. Products in this category are generally encapsulated, hermetically sealed, or located in clean rooms.
	Pollution Degree 2	Normally only dry, nonconductive pollution occurs. Occasionally a temporary conductivity that is caused by condensation must be expected. This location is a typical office/home environment. Temporary condensation occurs only when the product is out of service.
	Pollution Degree 3	Conductive pollution, or dry, nonconductive pollution that becomes conductive due to condensation. These are sheltered locations where neither temperature nor humidity is controlled. The area is protected from direct sunshine, rain, or direct wind.
	Pollution Degree 4	Pollution that generates persistent conductivity through conductive dust, rain, or snow. Typical outdoor locations.
Equipment type	Test and Measurement	
Safety Class	Class I	
Overvoltage Category	CAT II	
Pollution Degree	Pollution Degree 2	

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